International Partnership for Hydrogen and Fuel Cells in the Economy

United States Update

40th IPHE Steering Committee Meeting

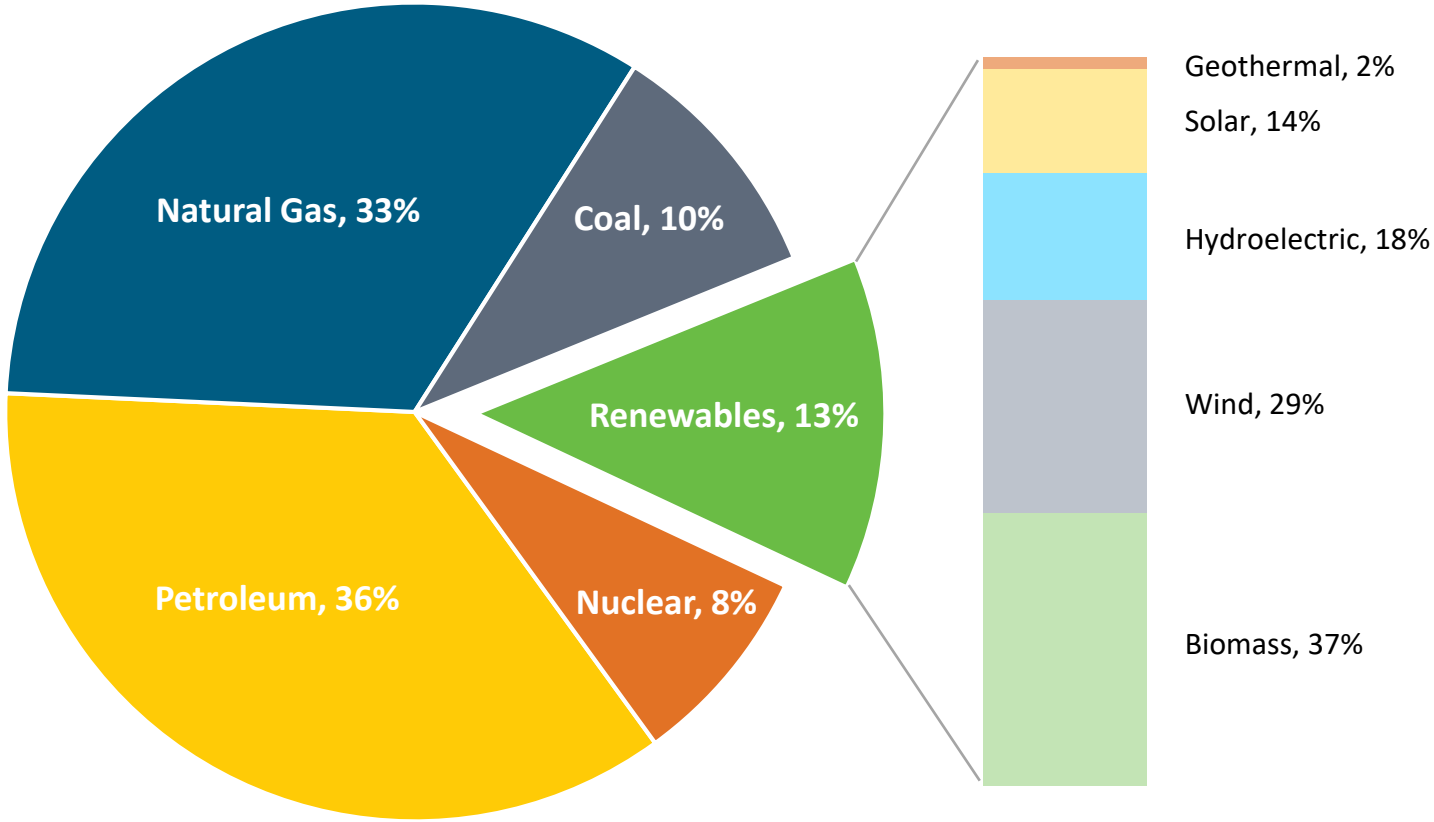
4 – 6 October 2023

Washington DC

U.S. Energy Landscape and Key Goals

U.S. primary energy consumption by energy source, 2022

Total = 100.4 quadrillion British thermal units (Btu)



Note: Sum of components may not equal 100% because of independent rounding
Source: Data collected from U.S. Energy Information Administration, May 2023, *Monthly Energy Review,* preliminary data

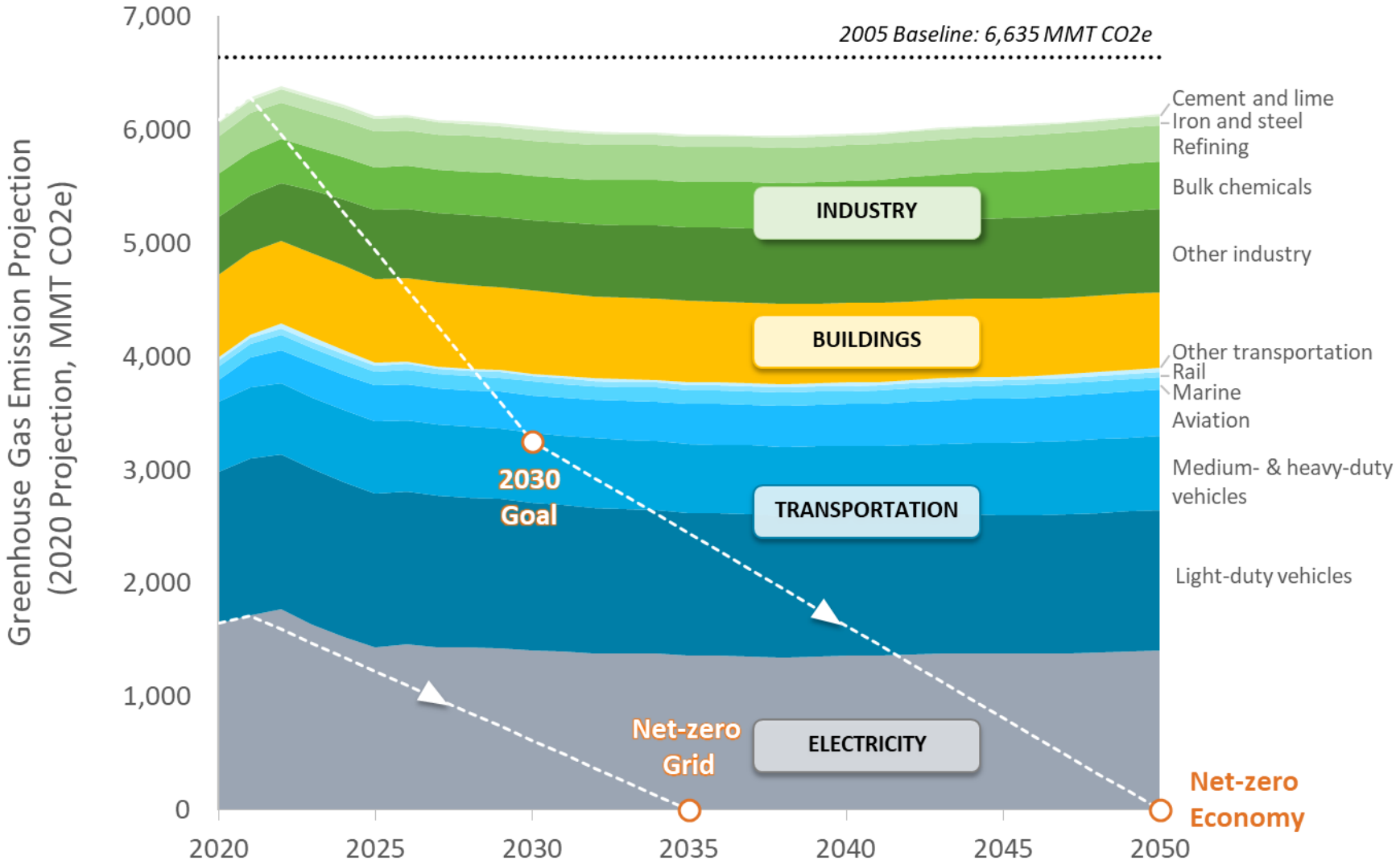
Administration Goals include:

- Net-zero emissions economy by 2050 and 50–52% reduction by 2030
- 100% carbon-pollution-free electric sector by 2035

Priorities: Ensure benefits to all Americans, focus on jobs, Justice40: 40% of benefits in disadvantaged communities

EJ: Environmental Justice

Carbon Dioxide Emissions by Sector



Source: National Clean Hydrogen Strategy and Roadmap based on Annual Energy Outlook 2021

Announcements / New Initiatives *United States*

Initiatives and Policies

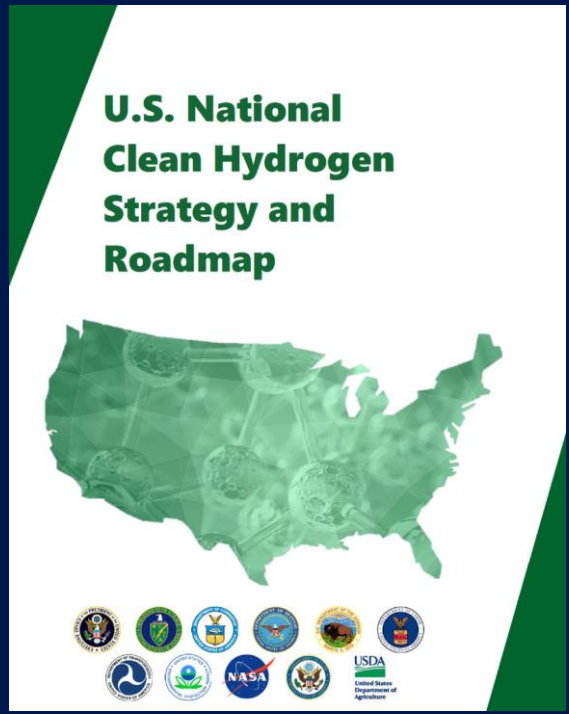
- **Released the US National Clean Hydrogen Strategy** and Roadmap
- **Various proposed and final rules at the federal govt level covering:**
  - Requirement of maintenance and corrective measures on pipeline safety, leakage
  - Control of air pollution/emissions from heavy duty engines and fossil power plants

New RDD&D Activities – Examples

- **Over $150 million announced to support nearly 70 projects to advance hydrogen RDD&D** such as electrolyzers, industrial decarbonization, infrastructure components, end-use tech. incl. fuel cells
- **Up to $1 billion announced for the demand-side initiative** to enable the Hubs.
- **5-fold increase in electrolyzer capacity (3.7 GW) in the US since 2022** announced

Collaborations

- **Announced formal collaboration across US federal agencies to execute the national hydrogen strategy** (Hydrogen Interagency Taskforce (HIT))
- **Collaborated with CEM H2I to launch H2 Twin Cities 2023** focusing on mentor-mentee partnerships

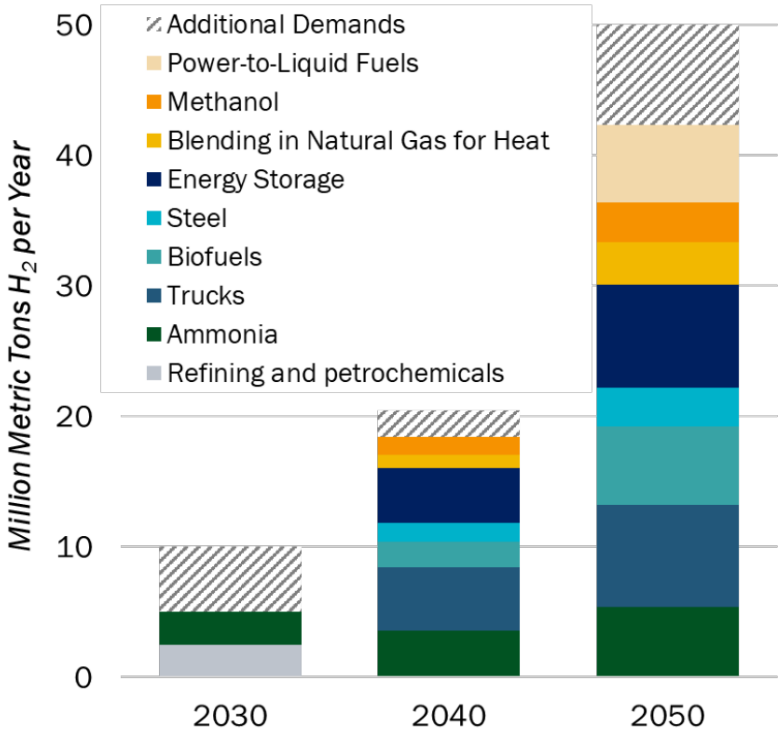


National Clean Hydrogen Strategy and Roadmap - The Opportunity:
10MMT/yr by 2030
20 MMT/yr by 2040
50MMT/yr by 2050

Only includes major announcement since last meeting

U.S. National Clean Hydrogen Strategy and Roadmap

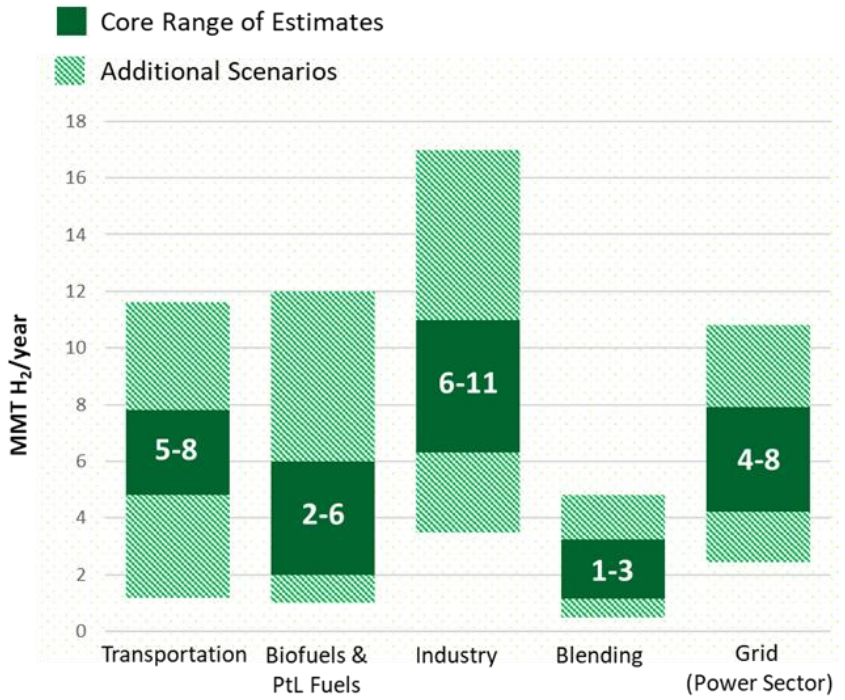
Opportunities for Clean Hydrogen Across Applications



Clean Hydrogen Use Scenarios

- Catalyze clean H_2 use in existing industries (ammonia, refineries), initiate new use (e.g., sustainable aviation fuels (SAFs), steel, potential exports)
- Scale up for heavy-duty transport, industry, and energy storage
- Market expansion across sectors for strategic, high-impact uses

Range of Potential Demand for Clean Hydrogen by 2050



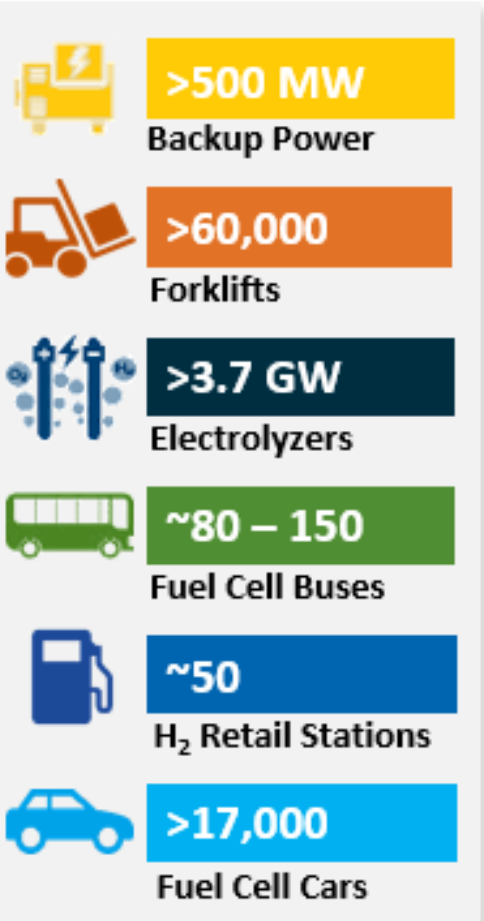
- **Core range: ~ 18–36 MMT H_2**
- **Higher range: ~ 36–56 MMT H_2**

U.S. Opportunity: 10MMT/yr by 2030, 20 MMT/yr by 2040, 50 MMT/yr by 2050. ~10% Emissions Reduction. ~100K Jobs by 2030

Refs: 1. NREL MDHD analysis using TEMPO model; 2. Analysis of biofuel pathways from NREL; 3. Synfuels analysis based off H2@Scale ; 4. Steel and ammonia demand estimates based off DOE Industrial Decarbonization Roadmap and H2@Scale. Methanol demands based off IRENA and IEA estimates; 5. Preliminary Analysis, NREL 100% Clean Grid Study; 6. DOE Solar Futures Study; 7. Princeton Net Zero America Study

United States – Profile October 2023

Status of Deployments



Leading Government Initiatives

ENERGY earthshots U.S. DEPARTMENT OF ENERGY | Hydrogen

IRA Hydrogen Incentives

Clean Hydrogen Production Tax Credit (up to $3/kg) and up to 30% Investment Tax Credit

Tax credit of up to 100K/30% of the cost of alternative fuel refueling property placed in service before 2033.

30% credit for commercial FCEVs through 2032 and $7,500 credit for new FCEV purchases.

Justice40 Initiative

40% of benefits from federal investments to disadvantaged communities (EJ40)

Diversity, Equity, Inclusion, and Accessibility (DEIA)

US Whole of Government Approach to H2 (HIT)

Deployment Goals

- **100% clean electricity grid by 2035**
- **Net-zero emissions by 2050**
- **50-52% emissions reductions by 2030**
- **Clean hydrogen production: 10 MMT by 2030; 20 MMT by 2040; 50 MMT by 2050**

H2@Scale U.S. Department of Energy

H2 Demo projects to enable at scale deployment and support climate goals

Goals or Focus Areas

Clean Hydrogen	Electrolyzers
$1/kg production $2/kg delivery $9/kWh storage	$150/kW 73% efficiency 80K hrs durability
Fuel Cells (HD)	**Enable J40 Priorities, DEIA**
$80/kW 25K hrs durability	

Funding

Bipartisan Infrastructure Law includes **$9.5B for Clean Hydrogen.** Funding announced includes:

- **$7B for H2Hubs**
- **$750 M** RD&D efforts for electrolysis, manufacturing, and recycling

2023 Budget for DOE Hydrogen Program: **~$418M**

Examples of Lessons Learned and Impact *United States*

Program initiative, policy, regulation, or mandate	Lessons Learned/Outcomes
Formation of the Hydrogen Joint Strategy Team (JST) within the US Department of Energy	• An agency/department with **multiple offices** working on various aspects of the hydrogen RD&D creates the **need for closer coordination**. • The creation of an **official team within an agency that that meets on a regular basis** and identifies clear roles for each office working on hydrogen can **help avoid duplication of efforts and foster a culture of information sharing**. • **Strong support and "buy in" across the agency, teams, and working groups** enables active engagement

Thank you

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